

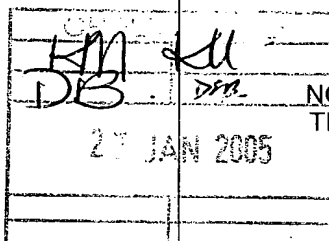
# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

## PCT

To:

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NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing  
(day/month/year)

26.01.2005

Applicant's or agent's file reference  
P/63767/GPTX14

### IMPORTANT NOTIFICATION

International application No.  
PCT/IB 03/05516

International filing date (day/month/year)  
14.10.2003

Priority date (day/month/year)  
14.10.2002

Applicant  
MARCONI COMMUNICATIONS SPA

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.
4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:



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# PATENT COOPERATION TREATY



# PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>P/63767/GPTX14</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. <b>PCT/IB 03/05516</b>	International filing date ( <i>day/month/year</i> ) <b>14.10.2003</b>	Priority date ( <i>day/month/year</i> ) <b>14.10.2002</b>
International Patent Classification (IPC) or both national classification and IPC <b>H04J14/00</b>		
Applicant <b>MARCONI COMMUNICATIONS SPA</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.  
  
☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).  
  
 These annexes consist of a total of 14 sheets.

3. This report contains indications relating to the following items:
  - I ☒ Basis of the opinion
  - II ☐ Priority
  - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - IV ☐ Lack of unity of invention
  - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - VI ☐ Certain documents cited
  - VII ☐ Certain defects in the international application
  - VIII ☐ Certain observations on the international application

Date of submission of the demand  <b>04.05.2004</b>	Date of completion of this report  <b>26.01.2005</b>
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  <b>Hes, R</b>  Telephone No. +31 70 340-3879  

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/IB 03/05516

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

4-27 as originally filed  
1-3 filed with telefax on 23.12.2004

**Claims, Numbers**

1-44 filed with telefax on 23.12.2004

**Drawings, Sheets**

1/5-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).  
☐ the language of publication of the international application (under Rule 48.3(b)).  
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority in written form.  
☐ furnished subsequently to this Authority in computer readable form.  
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.  
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/B 03/05516

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-44
	No: Claims	
Inventive step (IS)	Yes: Claims	1-44
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-44
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

- 1 Reference is made to the following document:

D1: US 2002/004843 A1 (DAVIES ELWYN ET AL) 10 January 2002 (2002-01-10)

- 2 The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):

A data communications system comprising a plurality of nodes and a plurality of links providing connections between the nodes (Figure 1);  
comprising a subset of the links and nodes for forming a worker path for carrying worker data through the communication system (paragraph 44);  
in which the system comprises a further subset of links and nodes for forming a plurality of protection paths for carrying non-worker data in the absence of a fault in the worker path (paragraph 43) and each for providing an alternative path for the worker data in a different part of the network in the event of a fault in the worker path (paragraph 43);  
in which the system comprises protection means, in which the alternative paths are predetermined by the protection means prior to the detection of a fault in the worker path (paragraph 21);

The subject-matter of claim 1 differs from this known from D1 in that:

the protection means is arranged to activate the entire plurality of protection paths to carry the worker data upon detection of a fault in the worker path;

the protection means is arranged to identify the location of the fault, to return the worker data to those parts of the worker path not affected by the fault and to deactivate any of the protection paths providing an alternative to those parts of the worker path not affected by fault.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to avoid continued reservation of detour paths after a network fault has been located (description page 5, lines 9-3 and page 14, lines 6-13).

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: the available prior art does not disclose nor hint at the problem or its solution, i.e. that upon fault location detection the worker data is returned to those parts of the worker path unaffected by the fault and that any of the protection paths providing an alternative to those unaffected parts of the worker is deactivated.

- 2.1 Claims 2-9 and 32-44 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3 Claim 10 is essentially a representation of claim 1 in terms of method steps. Therefore, the above arguments with respect to novelty and obviousness of the subject-matter of claim 1 similarly apply to claim 10. Consequently, the subject-matter of claim 10 is also new and inventive.
- 3.1 Claims 11-31 are dependent on claim 10 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

## COMMUNICATIONS SYSTEM

The present invention relates to the field of communications systems in general and to systems for protecting against the effects of equipment failure in communications systems in particular.

- 5 One of the most important concepts in network management is maintaining the survivability of networks. When there are either link or node failures any affected routes should be repaired as soon as possible. A node failure can be considered as the failure of multiple links, that is, a node failure affects the traffic the same way as if all links terminated on it were faulty. The present invention applies to both link and node diversity protection schemes: here diversity
- 10 relates to the property of the resources used by the protection path (links and/or nodes) to be fully disjoint from those used by the working path.

Because of the large volumes of traffic that networks are expected to carry, resulting from the continued explosive growth of data-oriented applications, network survivability has become an issue of paramount importance. In conjunction, there is a continuing drive for maximising

15 efficiency and minimising costs in large networks. Nodes are able to monitor the status of the connections passing through them to detect faults. In the SDH transport network, for example, this can be achieved using both trail monitoring and the so-called non-intrusive monitoring, both defined in the ITU-T specification G.783.

Traditional protection schemes, mainly used in ring networks, consume large amounts of

20 bandwidth. Shared protection (where resources are shared between a number of protection

paths) on mesh networks requires less additional capacity to provide fault protection than on ring networks. Although shared protection mesh networks consume fewer network resources, the trade-off has been in longer service restoration times. There is therefore a need for an appropriate architecture to enable fast restoration in such networks.

- 5 The present invention provides a data communications system comprising a plurality of nodes and a plurality of links for providing connections between the nodes; in which a subset of the links and nodes form a worker path for carrying worker data through the communication system; in which the system comprises a further subset of links and nodes for forming a plurality of protection paths for carrying non-worker data in the absence of a fault in the
- 10 worker path and each for providing an alternative path for the worker data in a different part of the worker path in the event of a fault in the worker path; in which the system comprises protection means, in which the alternative paths are predetermined by the protection means prior to the detection of a fault in the worker path; in which the protection means is arranged to activate the entire plurality of protection paths to carry the worker data upon detection of a
- 15 fault in the worker path; in which the protection means is arranged to identify the location of the fault, to return the worker data to those parts of the worker path not affected by the fault and to de-activate any of the protection paths providing an alternative to those parts of the worker not affected by the fault.

According to a preferred embodiment, the system comprises means for allocating the links

20 and nodes one or more cost values relative to the links and nodes of the worker path and



means for selecting on the basis of the one or more cost values a further subset of the nodes and links to form a protection path for at least one link or node of the worker path

The present invention also provides a method of protecting a worker path in a data communications system comprising a plurality of nodes and a plurality of links for providing  
5 connections between the nodes; including the steps of passing worker data through a subset of the links and nodes making up the worker path and designating a further subset of links and nodes to form a plurality of protection paths; in which the protection paths carry no worker data in the absence of a fault in the worker path and in which each provides an alternative path for the worker data in a different part of the worker path in the event of a fault in the worker  
10 path; including the steps of detecting a fault in the worker path and activating the entire plurality of protection paths to carry the worker data upon detection of a fault in the worker path; including the steps of identifying the location of the fault and returning the worker data to those parts of the worker path not affected by the fault and de-activating any of the protection paths that are providing an alternative for those parts of the worker path not affected  
15 by the fault.

According to a preferred embodiment, the present invention also provides a method including the steps of allocating the links and nodes one or more cost values relative to the links and nodes of the worker path and selecting on the basis of the one or more cost values a further subset of the nodes and links to form a protection path for at least one link or node of the  
20 worker path..

## CLAIMS

1. A data communications system comprising a plurality of nodes and a plurality of links for providing connections between the nodes;  
  
comprising a subset of the links and nodes for forming a worker path for carrying worker data through the communication system;  
  
in which the system comprises a further subset of links and nodes for forming a plurality of protection paths for carrying non-worker data in the absence of a fault in the worker path and each for providing an alternative path for the worker data in a different part of the worker path in the event of a fault in the worker path;  
  
in which the system comprises protection means, in which the alternative paths are predetermined by the protection means prior to the detection of a fault in the worker path;  
  
in which the protection means is arranged to activate the entire plurality of protection paths to carry the worker data upon detection of a fault in the worker path;  
  
in which the protection means is arranged to identify the location of the fault, to return the worker data to those parts of the worker path not affected by the fault and to de-activate any of the protection paths providing an alternative to those parts of the worker not affected by the fault.

2. The system according to any above claim, in which the nodes of the further subset comprise storage for storing the details of the protection path prior to the detection of a fault in the worker path.
3. The system according to Claim 2 in which the details of the protection path are associated with a unique path identifier.
4. The system according to Claim 2 or 3 in which each of the nodes of the further subset comprise a protection table for storing details of the protection path to which it belongs.
5. The system according to any above claim, in which at least one of the nodes common to both subsets comprises means for detecting a fault in the worker path and means to activate the protection path by sending an activate message to the nodes of the further subset upon detection of the fault in the worker path.
6. The system according to Claim 5 in which in which the nodes comprising means for sending the activate message also comprise means for sending the activate message to each adjacent node of the further subset.

7. The system according to Claim 5 or 6 in which the activate message contains a unique path identifier to inform the nodes of the further subset which connections to activate.
8. The system according to any above claim, in which the nodes comprise means for detecting the location of a fault in the worker path and means for, upon detection of the fault location, sending a deactivate message through the first subset in the direction away from the fault.
9. The system according to Claim 8 in which each node comprises means for detecting receipt of the deactivate message and upon receipt of such a message, to deactivate any path passing from that node via nodes of the further subset where those paths do not form an protection path to the faulty part of the worker path.
10. A method of protecting a worker path in a data communications system comprising a plurality of nodes and a plurality of links for providing connections between the nodes; including the steps of passing worker data through a subset of the links and nodes making up the worker path and designating a further subset of links and nodes to form a plurality of protection paths; in which the protection paths carry no worker data in the absence of a fault in the worker path and in which each provides an alternative path for the worker data in a different part of the worker path in the event of a fault in the worker path;

including the steps of detecting a fault in the worker path and activating the entire plurality of protection paths to carry the worker data upon detection of a fault in the worker path;  
including the steps of identifying the location of the fault and returning the worker data to those parts of the worker path not affected by the fault and de-activating any of the protection paths that are providing an alternative for those parts of the worker path not affected by the fault.

11. The method according to claim 10 including the step of storing the details of the protection path in the nodes of the further subset prior to the detection of a fault in the worker path.
12. The method according to claim 11 including the step of associating the details of the protection path with a unique path identifier.
13. The method according to claim 11 or 12 in which each of the nodes of the further subset comprise a protection table for storing details of the protection path of which it forms a part.
14. The method according to any of claims 10 to 13 including the steps of at least one of the nodes common to both subsets detecting a fault in the worker path and activating the

protection paths by sending an activate message to the nodes of the further subset upon detection of the fault in the worker path.

15. The method according to claim 14 including the step of the nodes sending the activate message sending it to each adjacent node of the further subset.
16. The method according to any of claims 14 to 15 including the step of including a unique path identifier in the activate message to inform the nodes of the further subset which connections to activate.
17. The method according to any of claims 10 to 16 including the steps of at least one node detecting the location of a fault in the worker path and, upon detection of the fault location, sending a deactivate message through the first subset in the direction away from the fault.
18. The method according to claim 17 including the steps of the nodes detecting receipt of the deactivate message and upon receipt of such a message, deactivating any path passing from that node via nodes of the further subset where those paths do not form a protection path to the faulty part of the worker path.

19. The method according to any of claims 10 to 18 comprising a plurality of nodes and a plurality of links for providing connections between the nodes; including the steps of allocating the links and nodes one or more cost values relative to the links and nodes of the worker path and selecting on the basis of the one or more cost values a further subset of the nodes and links to form a protection path for at least one link or node of the worker path.
20. The method as claimed in claim 19 including the steps of selecting the subset that has the lowest cost value.
21. The method as claimed in claims 19 to 20 including the steps of setting the one or more cost values for nodes and links on the worker path other than the at least one node or link to be protected lower than the cost value for other nodes and links.
22. The method as claimed in claim 21 in which the lower cost value is zero.
23. The method as claimed in claim 19 to 22 including the steps of setting the one or more cost values for the at least one node or link to be protected higher than the cost values for other nodes and links.

24. The method as claimed in claims 19 to 23 including the steps of setting the one or more cost values for the at least one node or link to be protected so that that node or link will not be selected.
25. The method as claimed in claims 19 to 24 in which the data communications system comprises a further worker path and protection for the further worker path.
26. The method as claimed in claim 25 including the steps of setting the one or more cost values relative to the worker path of a node or link to an intermediate value, provided that the nodes and/or links on the worker path and on the further worker path for protection by that node or link have no common point of failure.
27. The method as claimed in claim 26 in which the intermediate value lies between the higher and lower values.
28. The method as claimed in claim 27 including the steps of setting the one or more cost values relative to the worker path of a node or link to a higher value so that node or link



will not be selected, if the nodes and/or links on the worker path and on the further worker path for protection by that node or link have at least one common point of failure.

29. The method as claimed in claims 19 to 28 including the step of allocating each link and node one or more cost values relative to each link and node of the worker path.
30. The method as claimed in claims 19 to 29 including the steps of determining the protection path prior to the detection of a fault in the worker path.
31. The method as claimed in claims 25 to 30 including the steps of allocating the links and nodes a further cost value relative to the further worker path and selecting on the basis of the further cost value a further subset of the nodes and links to form the protection path for at least one link or node of the further worker path.
32. The data communications system of claims 1 to 9 in which the system comprises means for allocating the links and nodes one or more cost values relative to the links and nodes of the worker path and means for selecting on the basis of the one or more cost values a further subset of the nodes and links to form a protection path for at least one link or node of the worker path.

33. The system as claimed in claim 32 comprising means for selecting the subset that has the lowest cost value.
34. The system as claimed in claims 32 to 33 comprising means for allocating nodes or links on the worker path other than the at least one node or link to be protected a cost value lower than the cost value for other nodes and links.
35. The system as claimed in claim 34 in which the lower cost value is zero.
36. The system as claimed in claim 32 to 35 comprising means for allocating the at least one node or link to be protected a cost value higher than the cost value for other nodes and links.
37. The system as claimed in claims 32 to 36 in which a cost value for the node or link to be protected is set so that that node or link will not be selected.

38. The system as claimed in claims 32 to 37 comprising further subsets of the nodes and links for forming both a further worker path and a protection path for the further worker path.
39. The system as claimed in claim 38 comprising means for allocating to a node or link one or more intermediate cost values relative to each link and node of the worker path provided that that link or node in the worker path and the links and nodes in the further worker path protected by the node or link have no common point of failure.
40. The system as claimed in claim 39 in which the intermediate value lies between the higher and lower values.
41. The system as claimed in claim 40 comprising means for allocating to a node or link one or more higher cost values relative to the at least one link or node of the worker path so that that node or link will not be selected where the links and nodes in the worker path and links or nodes in the further worker path protected by the node or link have a common point of failure
42. The system as claimed in claims 32 to 41 including means for allocating the links and nodes a cost value relative to each link and node of the worker path.

43. The system as claimed in claim 32 to 42 in which the system comprises protection means for determining the protection path prior to the detection of a fault in the worker path.
44. The system as claimed in claims 37 to 43 comprising means for allocating the links and nodes a further cost value relative to the further worker path and for selecting on the basis of the further cost value a further subset of the nodes and links to form the protection path for at least one link or node of the further worker path.